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Resource Poor environment and Poverty Alleviation in Mbinga District: A Case of Malonga and Ngoro Systems of Land Resource Management in Matengo Highlands.

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1.0 Introduction

In Tanzania, many ethnic groups have over generations been practicing traditional land management techniques to achieve sustainable agriculture. These traditional practices include *Kara* in Ukerewe (Thorntone and Rounce, 1936), the *Iragw* in Mbulu (Hartely, 1938), *Luguru* in Morogoro (Temple, 1973), Chagga in Kilimanjaro (Young, 1989), *Injalila* and *Mabeti* in Makonde (Likanda *et al.*,1995) and *Kibanja* system in Bukoba. These systems are potential in maintaining the productivity of soils through prevention of soil erosion, conserving soil moisture, addition of soil nutrients, conserving soil organic matter or prevention of nutrient loss through a leaching process. These practices have been therefore thought to be environmentally sustainable.

In Songea Region and particularly Mbinga District on the Matengo highlands, people (Wamatengo) face a serious threat of soil degradation through water and leaching of erosion nutrient and therefore the sustainability of agricultural land productivity due to the invasion of unfriendly Malonga farming system. In the past, they locally evolved *ngoro* farming system long over a century as an attempt towards controlling soil erosion on steep slopes (Lyimo and Kangalawe 1997). There is evidence that through *ngoro* system, Matengo people have managed to protect the land they cultivate against soil erosion (Yanda *et. al.* 2000; Mung'ong'o, 1999; Mashindano 1998; Lyimo and Kangalawe 1997).

There is concern that in many areas within the country natural resources particularly the land has not been managed properly leading to degradation. Causes of land degradation are many (Figure 1), among them are poor agronomic practices such as causal burning of fields prior to cultivation, application of industrial fertilizers and use of pesticides. All these practices can cause pollution of the environment if not done properly. A farmer is a risk taker and has limited resources to enable him/her to perform agricultural activities. Resources needed by farmers are land (use), labor, capital and management. It is very important to recognize that these resources vary in-terms of quantity and quality both of which influence the performance of and potential of the agricultural system. A farmer is always in the processes of integrating these resources in order to meet the four basic needs which are, food, shelter, clothes and medical care. He or she is therefore fighting against poverty. It has been mentioned earlier that people have traditionally endeavored different ways of conserving land through proper agricultural practices. In Matengo highland, there is concern that a particular ethnic group (*Wanyasa*) has introduced a new system of land cultivation known as *Malonga*. This is believed to promote soil erosion because it involves the preparation of ridges along steep slopes (up to 60 degree slope). If the inversion of the sustainable *Ngoro* system by environmentally unfriendly systems like *Malonga* is left unchecked will lead to a total collapse of the *Ngoro* system and consequently enhancing soil erosion in the Matengo Highland. This study, therefore, attempts to investigate the raised potential problem of land degradation associated with the Malonga system in the Matengo highlands in Mbinga district, Ruvuma region. It is our hope that findings from this study will give some insights on the fate of agricultural farming systems in Matengo highlands and a way forward towards sustainable agriculture aimed at poverty alleviation.

2.0 Statement of the Problem

People living in Matengo highlands live in a complex physical environment characterised by steep slopes where they perform their farming activities. In managing this complex environment, they are facing problems of an increased human population leading to an intensive use of land, performing poor agronomic practices resulting into land degradation. In the past, their farming activities have been sustained through a farming system known as *Ngoro*. Recently, there is an invasion of the *Malonga* system that is likely to accelerate environmental degradation through soil erosion. These consequences are likely to increase poverty among peoples since the productivity of soils will be reduced. If *Malonga* system persists it could lead to severe environmental degradation in-terms of soil erosion leading to a declining soil fertility and thus resulting to a poor agricultural productivity. Thus, studies on soil vulnerability to erosion under *Malonga* and *Ngoro* systems are necessary. This could be achieved by assessing the stability to erosion of different soils found in both Ngoro and Malonga farming systems. It is also very important to investigate dynamics of soil fertility by evaluating the different soil conservation practises available and then provide recommendations. Since the problem of land degradation is aggravated by an increased human population (about 120 persons per sq. km.) it is therefore very important to understand the other coping strategies adopted in farming systems e.g. ratio of food and cash crops and reasons behind such strategies.

It is also important to establish motive behind establishing *Malonga* system in the area. It could be that it is poor people who cannot afford an elaborate system like *Matengo* either due to the limited resources or labor, perform such practice. This could then illustrate how poverty becomes a vicious cycle, in that poor people will continue to become poorer unless there is external intervention to break the cycle.

3.0 General Objective

To study the farming systems in Matengo highlands, their impacts on soil conservation and productivity and find out any coping strategies used by the people of Matengo to sustain their life in-terms of food and other basic human needs.

3.1 Specific Objectives

- To assess performance of the *Ngoro* and the *Malongo* farming systems in Matengo highlands in promoting soil fertility and conserving the soil.
- To establish socio-economic motives behind introduction of *Malonga* system
- To enumerate the different coping strategies adopted by matengo people on poverty alleviation in a highly populated Matengo highlands.
- To establish socio-economic motives behind the introduction of the *Malonga* system and how these motives are liked to poverty as compared to *Ngoro* system.

4.0 Rationale of the study

Generally, the different systems of land resource management and their social implications will be known after this study. It is also emphasized that shortcomings associated with *Malonga* farming system will be clearly known and thus enabling different stake-holders to take proper measurers to overcome these shortcomings. Furthermore, understanding of socio-economic conditions under which such a system is introduced provides an entry point for intervention measures. Findings from this study will therefore be used as modal for a sustainable management of a land resource in similar areas having a complex physical environment such as steep slopes. Finally, understanding the coping strategies particularly economic activities used by Matengo people in managing their life apart from agricultural activities.

5.0 Research questions

There are three main research questions in this study, which needs to be tackled. The first one is the understanding the source and origin of the *Malonga* farming system, motives behind introduction of the system, and its effect on the conservation land resource on the *Matengo* highland. More important is to look into ways in which the *Malonga* system may enhance or alleviate poverty as compared to the *Ngoro* system. The second question is to examine land degradation processes in the Matengo highland and study their socio-economic implications to Wamatengo people. The third question is to investigate with farmers some of the possible/ existing solutions (coping strategies) to the land degradation.

6.0 Literature Review

6.1 Farming systems

A farming system is defined as the arrangement of the farming enterprises that are managed in response to physical, biological and socio-economic environment and in accordance with the farmer's goals, preferences, and resources. It includes the use of natural resources available to the farm and the allocation of land, labour and money to each enterprise or household activities.

There has been an appreciation for the intricacies and adaptations incorporated into traditional farming systems (FS). Interest in this area gained pace within the last thirty years, where researchers have been trying to understand how indigenous people use their ecosystems in the country. This partly was attributed to, both fears that the knowledge would be lost and the difficulties experienced from farmers' failure to adopt new technologies. Aim of researchers is to develop research technique which could alleviate poverty by evaluating the usefulness of indigenous practices and providing alternatives to current practices e.g. through an increased crop productivity per given piece of land. However, only few researched works have been documented.

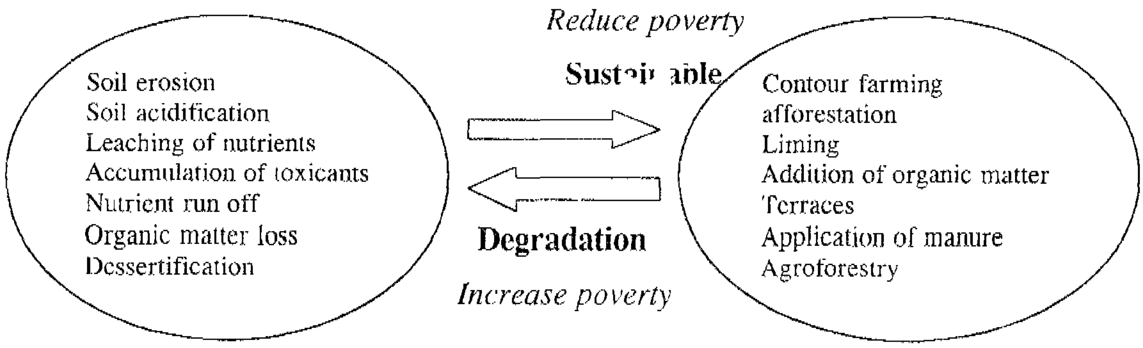
6.2 Sustainable and degrading agricultural systems

The farming practice adopted by farmers in a specific locality affects agricultural productivity, sustainability and poverty alleviation (Figure 1). We are examining these issues separately in the following sections. In order to avoid environmental degradation problems, awareness among different stakeholders and particularly the local community must be at large. The community needs to see that by not managing their farmimg systems properly degradation will occur. In many areas this is not the case as a result unproper practices are being used. For example, the processes of land degradation such as bare soils on agricultural land, formation of gullies, landslide, and pollution of lakes due to soil erosion in Ruvuma region is 82% recognized by peoples through education. Only 18% of the peoples detected land degradation through physical observation (Mashindano, 1998). This suggests that an effort is needed to make people to recognize themselves what is all about land degradation.

6.3 Farming system and land degradation

Unsustainable farming system is the one that enhances soil erosion, declining soil fertility, destruction of catchment areas, soil acidification, dessertification and etc. (Figure 1). When the above processes happen, the productivity of agricultural land is reduced and thus leading to food shortage as well as income among farmers. This will then result in poverty since peoples will not be able to meet their basic needs. Land degradation through soil erosion processes has been demonstrated to be accelerated by shifting cultivation practises in hills and reduced fallow period (Hurn, 1983). It is likely that the *Malonga* farming system in Mbinga is subjected to land degradation process through erosion because the current farming system of cultivating small ridges following the slope direction is not environmental friendly since it tends to encourage soil erosion process. Yanda *et al.* (2000) warns that if this system is not checked a severe damage of soil is likely to occur. On the other hand, it has been argued that environmental damage such as land degradation reflects outcome of market failure, usually due to over exploitation of natural resources. Unsustainable practices therefore such as deforestation, overgrazing, excessive use of agro-chemicals which may result into leaching, accumulation of toxic substances, increased surface run-off and sedimentation are the resulting external diseconomies (Mashindano, 1998). Case studies conducted in different parts of Tanzania have shown that land degradation process associated with soil erosion can severely damage soils and put them out of agriculture (Kikula and Mun'gong'o, 1993; Emma and Kikula, 1997; Majule, 1999).

Figure 1: Schematic representation of a sustainable and degrading systems



6.4 Farming system and sustainable agriculture

The aim of sustainable agriculture is to find ways of using agricultural land that achieve high and lasting productivity while maintaining and enhancing the natural resource base (Kotschi *et al.,* 1983). It represents successful management of resources for agriculture to satisfy the changing human needs while maintaining or enhancing the quality of the environment and conserving natural resources. As far as landscape is concerned, Kotschi *et al.* (1989) considered agriculture to be "site-appropriate" if it preserves all the functions of landscape in which it is inter-grated. Sustainable agriculture does not cover only biophysical aspects it includes economically viable, socially justice, humane and adaptable (Rentjes *et al.,*1992). For example, Mashindano (1998) states the corresponding benefit (external economies) of soil conservation practices namely agroforestry, terracing, manure farming, zero grazing etc are such as improvement of soil nutrient content and controlling water run off, leaching and sedimentation. These are also illustrated in Figure 1. Most recently, increased emphasis has been given to the sustainability as well as the productivity of the systems. For examples, studies conducted by Likanda *et al.* (1995) indicated that land degradation in the southern coastal areas of Tanzania particularly declining soil fertility is due to an increased pressure on land use resulting to reduction in fallow periods. In an attempt to reduce this problem a number of soil fertility conservation practices have been developed although only a few of them have been evaluated (see for example Temple, 1973; Likanda *et al.* 1997; Nkhalamba, 1999; Majule, 1999).

Agroforestry is one of the sustainable agricultural practices that have been developed in many tropical countries. This practice involves the integration of trees and crops whereby products can be fuel wood, timber, fodder, medicines, improve soil fertility or prevention of soil erosion. In mountainous areas in Rwanda, trees and shrubs planted along the contour line proved to be effective in protecting the soil from erosion because soil moves to areas between strips leading to the formation of terraces (Neuman and Pietrowicz, 1986). Other soil conservation practices, which have been adopted by Wamatengo, includes mixed cropping, grass mulching and composting (Mashindano 1998). Although stated that these methods are effective in improving soil fertility what is lacking is a scientific evaluation. Different types of compost manure added to different soils have shown to behave differently on soil properties and this has been explained to be determined by the properties of residue it self and the property of the soil to which residues are added (Majule, 1999: Nkhalamba, 1998; Sakala, 1998). Conclusions from these studies were derived after characterizing residues, soils and then study the behavior of residue added to soils.

6.5 The *ngoro* farming system

This is a farming system applied on sloping areas (landscape) aimed at checking soil erosoin whereby plants are planted on ridges. This system therefore stops water movement and then facilitate its soaking (Mashindano, 1998). It has been reported that the invasion by other tribes particularly the Wangoni forced Wamatengo to surrender the fertile low land soils and settle on mountaintops where land was becoming scarce and gradually infertile. The *Ngoro* system is believed to raise agricultural productivity in the fragile soils and highly populated Matengo highlands (Lyimo and Kangalawe, 1997, p2). The men cut the grasses and lay it in rows forming a grid; making sure however, that one set of rows always roughly followed the contour. The rows are two or three metres apart; with distance between them depending on the amount of grass to be covered and the depth of the soil with which to cover it. Using communal work parties, women do cultivation, but each field is individually owned. The soil in the squares is dug out and pulled on top of the rows of grass. Advantages of this system are the cultivators work around each square in turn. In this way one quarter of the work is done facing downhill and dragging the soil. This has the advantage of preventing soil erosion from the hilltops. Digging continues until the subsoil is exposed in each *ngoro* pit. The crop is planted on the raised beds surrounding the *ngoro* pits. Maize is normally planted in one field as a pure crop and beans and peas are planted as pure crops on the another. The plant beds are clean weeded; the weeds being pulled out and thrown into the pits to form compost. After harvest crop residues are also thrown into the *ngoro* pits, the old soil beds are splited and new beds formed over old pits. The new *ngoro* pits come to occupy the places where the former soil beds intersected. The rotation is strict, a grain crop, usually maize, alternating with a leguminous crop, normally beans and peas. According to Yanda *et. al.* (2000); Mun'ong'o (1999); Lyimo and Kangalawe (1997), the technique is very efficient against soil erosion. This is because the pits enable the overflowing water from one pit to be trapped in the next. Even heavy downpours are fully trapped and the water gradually sank into the subsoil (Mung'ong'o 1999, p50). Thus, through this system the Matengo people managed to have a constant cultivation without destroying the soils.

6.6 The *Malonga* farming system

This is a new land cultivation system introduced recently to the Matengo highlands. This method of cultivation has not been extensively studies but it has been reported by Yanda *et al.* (2000). *Malonga* system involves the making of ridges along slopes thus furrows between the ridges become the transporting agent of water. Since moving water tends to carry detached soil particles, this system was therefore observed to cause soil erosion. There are a lot of literature which suggests that cultivation of ridges against slope tends to conserve soil by reducing soil erosion. This reduction of soil erosion is usually associated with the conservation of other soil nutrients such as Ca, Mg and K (Majule, 1999). There is already a perception amongst farmers that soil fertility has been progressively declining, resulting in poor crop growth (Ellis-Jones *et al.*, 1994). Reasons for cultivating ridges along the slope of Matengo highlands and its fate on soil conservation are not clearly known. With regards to the origin of this system, it is argued that inter-marriages, lack of labor, as well as high migration of young generation particularly from Nyasa who live on the shore of the lake has been the cause. On the Shore Lake, *Malonga* system is practiced for the purpose of draining water for growing potatoes, which do not favor waterlogged environment. This system is therefore suitable on a particular environment depending on the soil type. As compared to *ngoro* system, which is rather difficult and require experience, people from *Nyasa* are forced to practice *Malonga* system that seems to be simple for them.

7.0 Hypotheses

- The *malonga* farming systems introduced in Matengo highlands has tended to encourage soil erosion.
- *Ngoro* farming system is comparatively better than *malonga* in conserving soil fertility.
- The on-going out-migration by Matengo ethnic group from highlands to lowlands causes environment destruction.
- An increased human population in Matengo highlands causes land shortages and this stimulates non-farming income generating activities.

8.0 The study methodology

8.1 The study area

Mbinga district is one of the four rural districts in Ruvuma regions. Others are Songea Urban, Songea Rural and Tunduru. Mbinga district occupies 11,396 sq. km (DALDO 1995) or 18% of the total regional area. About 26% of the district area is covered with water, 22% is forests, and 52% is arable land.

Mbinga district is divided administratively into 6 Divisions, 33 wards and 174 villages. The divisions are Mbinga urban, Mbuji, Nanswea, Ruhuhu, Ruhukei, and Mpepo. The dominant ethnic group is Matengo highlands, comprising about 60% of the district population. Other ethnic groups include Nyasa, Manda and Poto. These ethnic groups live along the shores of Lake Nyasa but sometimes they are generally referred to as WANYASA . There are few Ngoni people residing in the lowlands of Mbinga Urban division.

8.1.1 Population, density and growth rates

The population in the district increased from 144,059 people in 1967 to about 271, 845 people in 1988 an 89% increase during that period. The annual growth rate of the district population increased from 2.8% in 1967/78 to 3.3% in 1978/88 (URT, 1997). Using 3.3% growth rate, the population in the district for the year 2000 is estimated to be

379,496 people. This is equivalent 33 persons per sq. km, well above the regional average of 17 persons per sq. km[1].

Within the Matengo highlands there is unequitable population distribution. For example in Matengo highlands and lower matengo the population density is between 30 to 49 persons per sq. km compared to 15 persons per sq.km. in lakeshore (URT, Table1). In other studies (Yanda *et al.*, 2000; Mattee 1991) it has been reported that mountainous areas especially in the Matengo highland is highly concentrated with an average population of up to 120 persons per sq. km.

Polygamy is widely practiced in Mbinga district especially among the Matengo people. This practice has been adopted as a strategy to minimize the labour constraints in the households. The labour farming system which include the *ngoro* (Matengo pit) system and growing of coffee are labour demanding activities. Mbinga district experiences labour shortages especially in the coffee growing areas where everybody is busy attending his/her farm. This makes the supply of labour difficult. Having 2 or 3 wives increases the family labours force and reduces the need for hiring laborers. This could be also a reason for the increasing trend of intermarriages between Matengo in the highlands and Nyasa in the lakeshore zone.

8.1.2 Roads and infrastructure

Mbinga district is one of the districts in the country with poor roads and telecommunication. It has a road network of only 1053.4.km, out of which 17% have gravel surface and 83% have earth surface. The condition of the roads is almost impassable during wet season due to high mountainous terrain with steep slope.

Apart from road transport, Mbinga district is also heavily depending on marine transport. There are two ships owned by the Tanzania Railways Corporation (TRC). These are MV Iringa with 165 seats and MV Songea with 250 seats (Yanda *et. al.*, 2000). The ships operate between Kyela, Ludewa and Mbinga itself. In Mbinga the ports are Liuli, Mkili and Mbamba bay. The vessels also sail to some ports on the Malawi side, thus encouraging both local and international trade. In addition, there are considerable number of dugout canoes that are also used for marine transport.

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[1] Computed from URT 1997, Tables 1 and VIII

8.1.3 Agro-ecological zones

Mbinga district is generally divided into three distinct zones, namely the Matengo Highlands, the Lower Plateau, and the Lake Shore (Table 1). The Matengo zone covers Langiro, Litembo, western Myangayanga, and parts of southern Kigonsela and Liparamba wards. The altitude in this zone ranges between 1200 metres to over 1400 metres above sea level. This zone is characterized by strongly dissected mountain areas and narrow valleys and dissected plateau with shallow soils.

The Lower Matengo Plateau zone occupies the eastern parts of the northern and southern rolling hills including Tingi, most of Liparamba and eastern parts of Myangayanga and Kigonsela wards. Its altitude ranges between 1100 and 1300 metres above sea level. Most of the area is covered with miombo woodlands.

The Lake Nyasa Shores zone includes almost all of Ruhekei division and the Livingstone mountain bound it (Table 1).

8.1.4 Physical characteristics

8.1.4.1Temperature and rainfall

Climatically, Mbinga has a temperate to cool tropical type of climate with an average minimum ranging from 19 to 23¯C and maximum temperature ranging from 29 to 31¯C (Brown and Cochene, 1975). Due to broken topography, variations in temperature are very common and this creates microclimates in some places.

According to Ellis-Jones *et al.* (1994), the average annual rainfall in Mbinga District is 1224 mm varying from 1,000 mm to 1,600 mm. Rainfall normally begins from end of November and extends from December to April. During this period the area is generally humid. The growing season extends from six to seven months in the low altitude and mountain areas while it is up to nine months in the high altitude areas. Like many other parts of Tanzania the months of May to October are dry and the peak dry period is observed between June and October. During this period evapo-transpiration exceeds precipitation (ICRA, 1991).

Table 1.0 Agro-economic zones for Matengo Highlands

Zone	Morphology and Topography	Economic activities
The Matengo highlands		
Covers Lengiro, Litembo and Ndengu, Western Myenyanga and parts of Southern Kigonsela and Mpcramba	• Hilly highland altitude with a max. of [illegible]m. • Annual rainfall is between 1200-1400mm. • Dark brown to reddish soils. • Wooded grassland vegetation • Population density 30-49 per sq.km.	• Intensive cultivation ngoro system. • Crops grown include, coffee, maize, wheat, sunflower, beans and Irish potatoes. • Livestock include cattle, goats, poultry, pigs and sheep. • Soil conservation practices include terracing, ridging, mulching, crop rotation and interplanting.
Lower Matengo		
Area covered is Tingi division, most of Liparamba and Eastern parts of Muyanyanga and Kigonsera	• Very hilly area altitude ranging between 800-1500m. • Average annual rainfall 1100-1300mm • Soils include deep, dark reddish brown to red sandy clay loams. • Vegetation includes miombo woodland. • Very low population density of under 15 persons per sq.km	• Agricultural activities include mainly cultivation crops. • Crops include tobacco, maize, cassava, beans, sesame and fingermillet. • Fewer cattle, goats, sheep, pig and poultry. Honey collection is also important. • Soil conservation is done through shifting cultivation, interplanting, ridging, mulch and use of manure. Chemical fertilizer used occasionally
Lake shore		
This is a narrow zone bordering lake Nyasa, an area of approximately 1700 sq.km. , 12 Km long north eastern shore of Lake Nyasa. It includes almost all of Ruhekei division. It is bounded on the east by the Livingstone mountains.	• Flood plains area bounded by mountainous land. Altitude rises from 500m at the edge of Lake Nyasa to 600m in the foothills of the Livingstone Mountains. • Rainfall varies between 100mm in the north to over 1400mm south. The yearly minimum rainfall is between 500-1000mm. • Soils are very dark grey silts and clay with dark brown sands and loams with low fertility and poorly drained • Vegetation mainly grassland and woodland on the highland. • Population density is medium ranging from 30-49 persons per sq.km.	• Agriculture including cultivation of crops like cassava, groundnuts, beans, paddy, coconuts, maize, sorghum, some bananas, fruits and oil palms. • Livestock includes cattle, goats, sheep, pigs and poultry. • Soil conservation methods includes ridging, fallow and interplanting.

Source: Modified after URT (1997)

8.1.4.2Soils and Physiography

Generally, soils of Mbinga are classified depending on their position in the soil catena or topography. Soils found on elevations is originated from granitic and gneisses material and are highly weathered, leached and well-drained sandy clays (ICRA, 1991). On the Matengo highlands soils tend to be shallower with impended drainage in some places. They are dark brown to reddish in colour (Table 1) Less leached reddish soils with brown sandy clays and sandy loams and sandy clays are found at lower elevations (Ellis-Jones *et al.*, 1994). Soils of the lower elevation are ferralitic in nature and are very susceptible to soil erosion because they are very friable and become softens by rains (ICRA, 1991; Mashindano, 1998). On the other hand soils on the lakeshore are very dark, grey silt and clay with dark brown sands and loams with low fertility and poorly drained (Table 1). Since these soils from highlands have been subjected to different tillage practices such as *ngoro* method and ridge making it is likely that their vulnerability to erosion has changed and this needs to be investigated.

8.1.5 Vegetation

The miombo woodlands in most areas of Matengo highlands had almost completely disappeared suggesting forest encroachment. At low elevation the dominant vegetation type is secondary wooded grassland. Dominant grass species are *Hyperrhenia* spp, and *Hypotheca* spp. Common species in wooded grasslands are *Parinaria curatefollia, Acasia albida, Acacia polyancantha, Brachystegia* spp and *Jubernadia glabiflora*. Dominant species in valley bottoms, creeks and wetlands areas are *Bridelai micranta, Treculia africana, Fragnitas maritariana* (ICRA, 1991; Ellis-Jones *et al.*, 1994).

8.1.6 Economic activities

Over 50% of the total district area is suitable for agriculture (Yanda *et al.*, 2000, p20) and the majority of people depend on agriculture, which accounts for a larger part of the income generated in the District. Farmers grow a range of food crops including maize, cassava, potatoes and wheat. Other food crops grown as relish are beans and cow peas. A major cash crop grown in Mtengo highland is coffee but other crops like maize, beans and finger millet are also important in generating income.

Due to high population density in the Matengo highlands, intensive farming system that include *ngoro* system, contour and terracing are widely practiced (URT, 1997). Most farmers use ngoro system to grow crops like beans, maize, sweet potatoes and cassava. Terracing is used in coffee farms. Shifting cultivation is practiced in Litumbandyosi, Liparamba, and Luhekei wards. These are also areas where migrants from Matengo highlands tend to move in.

Livestock production in Mbinga District does not contribute much to the economy of the people although there is a report which suggests an increasing number of livestock (MoA, 1993). Cattle and goat are mainly kept for dowry, pigs and chicken are kept on a very small scale.

8.1.7 Land ownership, tenure and farm sizes

Land ownership in Mbinga District does not differ much from what can be seen in other parts of the country. Land is publicly held and the maintenance and improvement of the quality of land depends upon the user. Customary land ownership is strong and family owns land and inheritance patterns is patrilinear. Because of an increasing population pressure, in these highlands there has been a continued decline in average farm size and fragmentation of crop fields. Following this, Matengo people have started to value land where land transactions are not uncommon currently. The average farm size ranges between 5-8 acres per household (Lyimo and Kangalawe, 1997).

8.2 Data collection

About six villages will be surveyed for the purpose, three from one transect and the other three from the other transect. Each of the villages surveyed will be from upper pediment (upland), mid pediment (midland) and lower pediment (lowland). Villages will be selected carefully in order to make sure that the three soil management practices are available.

8.2.1 Secondary data collection

Secondary data regarding farming systems, types of soils, coping strategies for poverty alleviation, out-migration trend and other socio-economic issues will be collected from different sources including literature search in libraries and documentation centres, government organizations and/or agencies, NGO's and private sector in the locality.

8.2.2 Primary data collection

A growing awareness of the failures of conventional approaches in meeting the needs of people has led to the exploration of alternative methods of investigating poverty and resource management issues, and planning research and development issues (Devavaram 1992, p1). Given the nature of this study (where little is known about *malongo* farming system) and the situation on the ground (poor road and infrastructure) both Participatory Rural Appraisal (PRA) technique and physical collection of soil samples from different fields will be applied. Participatory Rural Appraisal is a composite of technique that involves interactive learning, key informants, direct conversation including wandering around, shared knowledge, quantification, flexible yet structured analysis, workshops and brainstorming (Chamber, 1992). Farmers will be asked to:

- List all indigenous methods of cultivation (in different soil types) available in their villages.
- Rank these methods in order of their importance.
- Enumerate all prons and cons of each practice.
- Then a question on the origins of each practice will be asked as well as.
- Make a list of different crops grown in different land management practices and explore why different crops.

A structured questionnaire will be used to gather specific information of interest in detail as addressed by researchers.

8.2.2.1Sample size and sampling technique

In this study it is emphasized that a total of 300 households will be interviewed, 150 households from each of the two transects. From each village, 50 households will be interviewed. In this study, soil samples will be collected along two transects which represent a catena. Samples will be collected from villages selected i.e from the upper pediment, mid pediment and finally at the lower pediment or valley bottom. Likewise in many other similar areas, sites will have different soil types thus allowing us to compare the effects of the different land management systems on soil properties. Soil samples will be collected from *Ngoro, Malonga,* and any one common soil conservation practice of interest that will be observed. A *W* soil sampling technique (Rowell, 1997) whereby a number of samples (about 20 sub samples) are collected in one representative unit (soil conservation practice) are collected and mixed together to get one composite samples. Samples will be collected from 5 fields each under Ngoro, Malonga and from other method of conservation. This sampling regime was used by Yanda *et al.* (2001) in a study conducted in Tabora to investigate reasons for encroachment of land.

8.2.2 Determination of water soluble aggregates in soils

Agents of soil erosion which act upon soils are water, which can be due to rainfall, wind and gravity. These act upon the soil but the ability of the soil to erode depends on several factors such as soil texture, soil structure and the stability of the aggregate. The stability of aggregate of soils depends on the degree of cementation of soil aggregate, which determine the ability of the soil particles to detach from aggregates. The determinations of the solubility of soil particles in water that can be transported have been used to explain the ability of different soils to erode. The method for determining water-soluble aggregate described by Van Bavel, (1952) and Low (1954) is described below.

In this method, a field sample is collected, dried in air for 48 hours and pushed through a 10 mm and then passed through 5mm sieve before re-wetting. A complete soaking of soil normally carries out re-wetting. After soaking in water for 30 minutes the soil is tipped into the middle of the uppermost sieve. In this process sieves of 2, 1, 0.5, 0.125 and 0.100 mm are used. Sieves containing wet soil are agitated for about 17 minutes in order to break down soil aggregates. After agitation all particles > 0.5 mm diameter are retained, air dried and the estimated in % from total weight of aggregate. This fraction is broken further by puddling in a beaker sieved again in > 0.5 mm sieve oven dry and weigh the stones left on this sieve.

The final result will give the % of soil less than 0.5 mm in diameter that is present in the water stable aggregates greater than 0.5 mm in diameter. So by estimating this fraction in different soils, the ability of soils to erode can be established.

8.3 Data processing and analysis

After PRA exercise, selected farmers will be asked to visit sites and collect different soil samples for laboratory examination. In the laboratory soils will be examined for aggregate stability, water-holding capacity, and composition of various nutrients such as soil organic matter, exchangeable bases and available phosphorus the procedures adopted. Soil chemical parameters obtained will be compared to standards proposed by NSS (in press) and these will be displayed in the form of Bar charts, Tables of graphs in order to observe some trends or differences associated with the different management systems. Socio-economic data will be compiled and analyzed by using SSSP package and results will be displayed in the form of Tables, Bar charts, Figures or Pie charts. All these analyses will be used to test the hypotheses developed in section 5.0.

9.0 Workplan and Timeframe

Table 2. Summary of activities and work plan

Period	Activity planned
Phase 1	-Literature Review, preparations of field work plan. -Executing 15 days field work to collect both secondary data and survey data in Mbinga district. -Identification of sites and collection of baseline data (soil samples, crop data and for the
Phase 2	-Compilation of field data collected in phase one. -Collection of data on soils, crops and soil erosion from monitoring sites. -Revisit and cross checking of findings observed in phase 1 -Data analysis and production of first draft of report to be submitted to REPOA -Preparation of a paper for publication in an identified international journal.

10.0 Proposed budget (Table 3)

Category/Item	Costs	
	US$	LC (Tshs)
Personnel		
´ Research assistant (2), data analysis x 30$ per days x 30 days	1800	1,458,000
´ Survey interviewers (local) 5 persons x 15 days x 10$ per day	750	607,500
Subtotal 1	**2550**	**2,065,500**
Local travel		
´ Vehicle rental + fuel (2500 km return DSM) x 2 trips x 0.75$	3750	3,037,500
´ Repairs/service	1000	810,000
Subtotal 2	**4750**	**3,847,500**
Services		
´ Laboratory analysis (soils)	2000	1,620,000
´ Secretarial	400	324,000
Subtotal 3	**2400**	**1,944,000**
Field Subsistence		
´ Per diem researchers (60$ x 3 Scientists x 15 days x 2 trips)	5400	4,374,000
´ Follow-up trip. I researcher x 10 days x 60$	600	486,000
Subtotal 4	**6000**	**4,860,000**
Equipment/consumables		
´ Diskettes	50	40,500
´ Video cassettes	60	48,600
´ Batteries	20	32,400
´ Polyethylene bags	20	16,200
´ Plastic bags	50	40,500
´ Stationery	200	162,000
Subtotal 5	**400**	**324,000**
Material Production		
´ Photocopying	200	162,000
´ Typing	124	100,000
´ Photography (printing)	62	50,000
´ Video editing	62	50,000
Subtotal 6	**448**	**362,000**
Dissemination, linkage, networking		
´ Leaf lets production, publications	1000	810,000
Subtotal 7	**1000**	**810,000**
Total Research Budget	**17540**	**29,835,540**
10% contingency	**1754**	**1,420,740**
Total	**19294**	**31,256,280**

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